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A micromechanical model of graphene-reinforced metal matrix nanocomposites with consideration of graphene orientations

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Abstract

In this paper, a new micromechanical model is developed for graphene-reinforced metal matrix nanocomposites (MMNCs) to effectively describe the mechanical properties of the new attractive engineering materials with high specific strength. The key influence of the misorientation of randomly-distributed graphene nanoplatelets (GNPs) is especially considered. The strain rate and temperature effects are also introduced through the dislocation-mechanics-based metal matrix model. Then the new model is applied to the nanocomposites of GNP/Al₂₀₂₄, GNP/Al and GNP/Cu, respectively. The comparison of model predictions and experimental data suggests that the model can represent the elastoplastic deformation behaviors of the graphene-reinforced MMNCs well. The strengthening effect by graphene in the nanocomposites is approximately linear to its volume fraction within a small range and also to the aspect ratio of graphene

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